Stigmodera cancellata Don, 1805
(= *dejeani* Hope, 1836; *dejeaneana* Boisd., 1835).

Colour and pattern much the same as in *Stigmodera roei* with the same variations as to blue and yellow varieties. The beetle is, however, much flatter and more elongate than *roei*. The underside is coppery green, thorax coppery green, sometimes purplish, elytra green with six reddish spots. The spots in both *cancellata* and *roei* range in their colour patterns from reddish-orange to blood-red, and the rest of the body from green to blue. Length, 20-34 mm.

This beetle has been taken in the following districts: Northam, Wembley, Bunbury, Busselton, Augusta, Denmark and Albany.

Food plants are Geraldton Wax, *Leptospermum* and Peppermint. In the coastal areas it breeds in Peppermints, the adult beetle emerging during October and November. Some specimens have been collected in December.

EVIDENCE OF A MID-RECENT CHANGE OF SEA-LEVEL AT COTTESLOE

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I.—INTRODUCTION.

The mean sea-level during the Mid-Recent epoch of geological time (3,000 to 5,000 years ago) was 10 to 11 feet higher than it is at present. Fairbridge (1950a) believes that this sea-level in Western Australia was at its highest during the warm "Atlantic" stage of the climate which is well documented in Western Europe. The stable coastline of Western Australia, and the presence of a narrow belt of soft dune limestones, into which each stand of the sea cuts a characteristic notch or undercut (see Figs. 1 and 2) makes it ideal for the study of these eustatic changes in sea-level.

The physiographic features associated with the 10 ft. rise are particularly well preserved along most of our coastline, and were cited as evidence of uplift of the land by Somerville (1921). That they could be correlated with a world wide fluctuation in sea-level was first recognised by Teichert (1950) who made a study of the evidence to be found on Rottnest Island. Supporting evidence from the mainland was brought forward by Fairbridge (1950b) from the Point Peron area.

Three theories as to the origin of the variations in mean sea-level are currently held. The first attributes them to climatic fluctuations, causing varying amounts of water to be withdrawn from the sea and held in polar ice caps. The second to structural changes in the earth's crust, such as raising and lowering of the ocean floors and continents. The third to the displacement of water by sediment brought down by the rivers and deposited in the sea; this, of course, can only account for minor rises in mean sea-level. However, it seems more desirable at the present time to retain a multiple hypothesis than to attempt to ascribe the changing sea-level to any particular cause.

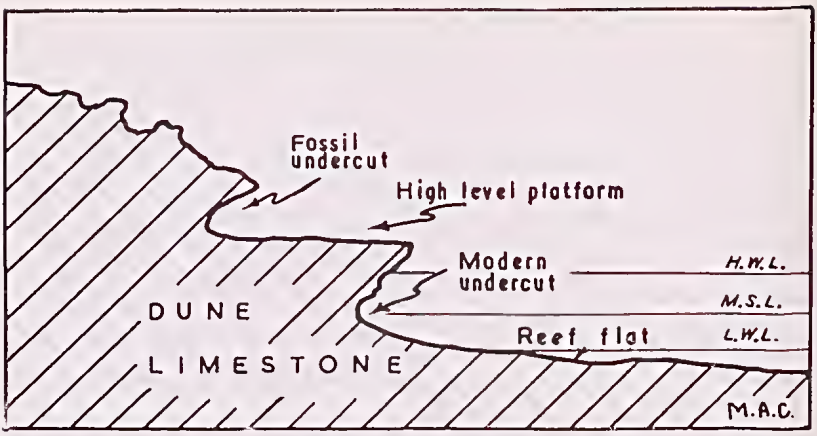

Fig. 1.—Diagrammatic cross-section of the headland at the bottom of Beach Street.

II.—EVIDENCE AT COTTESLOE

On the rocky headland south of Cottesloe beach, at the bottom of Beach Street, due west of Mosman Park Railway Station, are the physiographic features under discussion. They are the result of a higher sea-level than that existing today. It has cut into the limestone forming an undercut and depositing beds of shells which are now well above the reach of the present day seas.

The presence, on this headland, of the high level platform and undercut, and fossil shell beds, was first noted by Somerville (1921) who estimated that the shell beds extended up to 23 feet

Fig. 2.—Fossil undercut with remnants of the high level platform in the foreground.

above datum, mean low water springs (this level roughly coincides with that of the wide shallow contemporary reef flats developed on almost all the rocky limestone outcrops along the Western Australian coastline, thus shore line erosion features can be referred to the level of this reef flat as a first approximation to datum).

(a) *The High Level Platform.* A high level platform and its fossil undercut are well preserved in this area (see Fig. 2). These features are about 6 ft. higher than their present day counterparts. Remnants of a platform of this height have been recognised by Fairbridge at Point Peron and are regarded by him as being slightly younger and less well preserved than the highest or 10 ft. platform in this area.

The fossil undercut is nearly 3 ft. high (see Figs. 1 and 2), and as it was formed in the intertidal belt this gives a good idea of the mean spring range of the prevailing tides. The modern undercut here is about 5 ft. high because it has had a composite origin, being notched by the present sea-level together with a stand two feet higher. When it is found alone the undercut result-

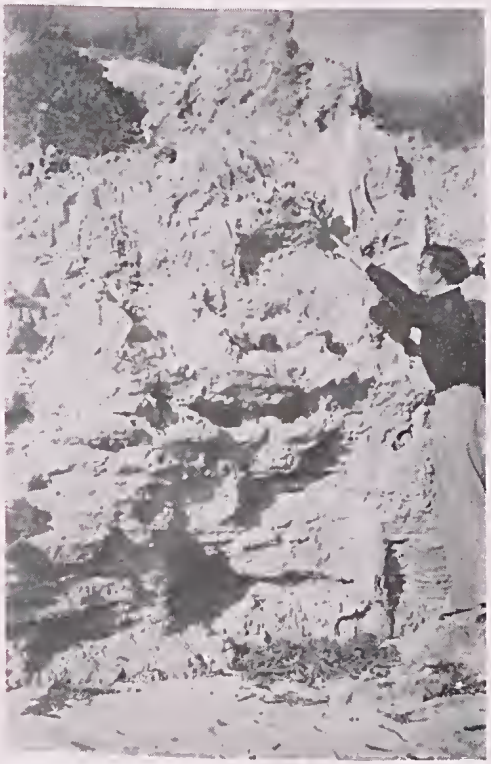

Fig. 3.—Fossil shell beds. The man is standing at the same height as the high level platform and pointing to the highest fossil horizon. In the foreground is beach sand piled up by storm waves. —Photos by S.D.C.

ing from the present sea-level is about 3 ft. high and thus corresponds to the 3 ft. mean spring tidal range. It is very well developed in this area and has an overhang of at least twenty feet.

(b) *The Shell Beds.* The shell beds are 9 to 10 ft. thick (see Fig. 3). The base of the beds is at the same height as the top of the high level platform, the highest fossil horizon is thus nearly 20 feet above datum. The shell beds are in places cut through by solution pipes.

Between these rocks and the Cable Station, a quarter of a mile south along the beach, Somerville has measured the sandy beds up to 23 feet above datum. As mentioned previously he cited this as evidence of an uplift of the land to that extent. In the writers' opinions these beds are beach deposits of the 10 ft. sea-level, shells being deposited up to the 20 ft. level (above datum) in the swash zone of a shelving beach. Analogous deposits in the same zone of the present sea-level are to be seen 10 ft. above the modern reef flat.

The fauna of the shell beds is very similar to that of the present day. Reath (1925) has cited specimens collected at Fremantle from the continuation of the Cottesloe beds as evidence of warmer seas at the time of deposition. After comparing Reath's list with that of B. C. Cotton in Fairbridge (1950b) the writers found that of four species recorded by Reath as indicative of warmer seas, two were recorded by Cotton at Point Peron as living on the reefs, viz. *Turbo pulcher* (Menke) and *Tonna variegata* (Lamarck). Of the other two it was found that *Area fusca* (Reeve) of Reath's list can only be differentiated from *Barbatia pistachia* (Lamarck) of Cotton's list with certainty on the basis of colour, hairs on the periostracum, and a variation in shape, being slightly more inflated (Allan, 1950, p. 254). The former two characters are absent in the fossil state and the third alone is hardly sufficient justification to separate the species. Further, the fourth species *Hipponix antiquata* (Linne) of Reath's list is recorded in a checklist by Hedley (1916) who took it from a list of identifications of shells from Geraldton by Verco (1912) where it is called *Capulus antiquatus* (Linne) and is recorded as also occurring at the present time in South Australian waters and is thus not indicative of warmer seas.

We have classified our specimens by comparison with the modern fauna and have followed the nomenclature of Cotton. A complete faunal list of the Cottesloe shell beds has not been prepared, but common species present are:—

Class Gasteropoda: *Melanerita melanotragus* (Smith), *Austrochochlea rudis* (Gray), *Bullaria tenuissima* (Sowerby), *Floraconus anemone* (Lamarck), *Notoaemea septiformis* (Angas), *Patelloida altieostata* (Angas), *Sabia conica* (Schumacher), *Nerita lineata* (Gmelin), *Sophismalepas nigrita* (Sowerby), *Ninella torquatus* (Gmelin), *Siphonaria baconi* (Reeve), *Euplica bidentata* (Menke), *Marinauris spp., Niotha pyrrhus* (Menke), *Tonna variegata* (Lamarck), *Propesinum*

pictum (Reeluz), *Dicathais aegrota* (Reeve), *Phasianella spp.*, *Herpetopoma aspersa* (Phillipi).

Class Lamellibranchiata: *Barbatia pistachia* (Lamarek), *Glycymeris striatularis* (Lamarek), *Brachyodontes erosus* (Lamarck), *Gomphina undulosa* (Lamarek).

Class Cirripedia: *Balanus spp.*

These are all contemporary reef dwelling forms indicating, as suggested by the high level platform and undercut, the proximity of a reef flat habitat during life.

III.—CONCLUSIONS

There is evidence in the form of an emerged platform and undercut of a change in sea-level of approximately 10 ft., which has been correlated with the warm climatic period of 4,000 to 5,000 years ago. Fossil shell beds up to 20 ft. above datum have been deposited by this sea-level. The fauna of these beds are all species at present living in the reef flat environment the dead shells of which are deposited on the contemporary beaches in the Fremantle-Cottesloe area. The high level shell beds do not indicate, as thought by Somerville (1921), a rise of sea-level of 23 ft.

Re-examination of Reath's 1925 faunal list from the sub-recent shell beds of the Perth area has shown that of the four species previously cited by him as indicative of warmer seas than those now prevailing, two are, in fact, living on the reefs off Fremantle today; another is recorded from South Australian waters. The fourth is a doubtful identification and the original specimen should be consulted and the species determination reviewed. The fauna gives no evidence of a change in the temperature of the sea during the time of the 10 ft. sea-level.

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